Questions 51 – 65 odd, 69 – 73 odd, 96, 109

51) $\frac{2.00\text{L } O_2}{22.4\text{L } O_2} \left| \frac{1 \text{ mol } O_2}{3 \text{ mol } O_2} \right| \frac{4 \text{ mol Fe}}{1 \text{ mol Fe}} \left| \frac{55.85 \text{ g Fe}}{} \right.$ = ***3.21 g Fe***

53) $\frac{70.0 \text{ L } N_2}{22.4\text{L } N_2} \left| \frac{1 \text{ mol } N_2}{3 \text{ mol } N_2} \right| \frac{2 \text{ mol } NaN_3}{1 \text{ mol } NaN_3} \left| \frac{65.02 \text{ g } NaN_3}{} \right.$ = ***135 g NaN_3***

55) $4800 \text{ m}^3 \text{ } H_2 \left(\frac{10 \text{ dm}}{1 \text{ m}} \right)^3 \left| \frac{1 \text{ L}}{1 \text{ dm}^3} \right| \frac{80 \text{ L}}{100 \text{ L}} \left| \frac{1 \text{ mol } H_2}{22.4\text{L } H_2} \right| \frac{1 \text{ mol Fe}}{1 \text{ mol } H_2} \left| \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} \right.$ = ***1.5×10^7g Fe***

$\frac{1 \text{ mol } H_2SO_4}{1 \text{ mol } H_2} \left| \frac{98.09 \text{ g } H_2SO_4}{1 \text{ mol } H_2SO_4} \right| \frac{100 \text{ g solution}}{98 \text{ g } H_2SO_4}$ = ***2.6×10^7g H_2SO_4***

You will save time in the future if you remember that $1m^3 = 1000L$

57) $2CH_3OH + 3O_2 \longrightarrow 2CO_2 + 4H_2O$

$\frac{50.0\text{mL } CH_3OH}{1\text{mL } CH_3OH} \left| \frac{0.85\text{g } CH_3OH}{32.04\text{g } CH_3OH} \right| \frac{1 \text{ mol } CH_3OH}{}$ = 1.326 mol CH_3OH / 2 = 0.663

PV = nRT

(2.00) 22.8 = n (.08206) (300.) n = 1.852 mol O_2 / 3 = 0.617

limiting reactant

$\frac{1.852 \text{ mol } O_2}{3 \text{ mol } O_2} \left| \frac{4 \text{ mol } H_2O}{} \right.$ = ***2.47 mol H_2O***

59) a. $2CH_4 + 2NH_3 + \mathbf{3}O_2 \longrightarrow 2HCN + 6H_2O$

Since we have equal amounts of all 3 reactants, O_2 is the limiting reactant.

$\frac{20.0 \text{ L } O_2}{3 \text{ L } O_2} \left| \frac{2 \text{ L HCN}}{} \right.$ = ***13.3 L HCN***

61) $\frac{3.164 \text{ g } X_2}{1 \text{ L } X_2} \left| \frac{22.4 \text{ L } X_2}{1 \text{ mol } X_2} \right. = \frac{70.87 \text{ g/mol } X_2}{2}$ = ***35.44 g/mol X*** X = Chlorine

63) To calculate density we first need volume. (Assume 1 mole)

PV = nRT

(0.9802atm) V = 1mol (0.08206) 333K V = 27.88L

$D = \frac{\text{mass}}{\text{volume}} = \frac{352.0\text{g}}{27.88 \text{ L}}$ = ***12.6 g/L***

65) $\frac{7.8\text{ g } CO_2}{} \left| \frac{1\text{ mol } CO_2}{44.01\text{ g } CO_2} \right. = 0.177\text{ mol } CO_2$

$PV = nRT$

$P(4.0) = 0.177\,(0.08206)\,300$

$P = 1.1\text{ atm}$

With air at 740 torr, the partial pressure would be the same (1.1 atm)

$P_{total} = P_{CO2} + P_{air} = 1.1\text{atm} + .97\text{ atm} =$ ***2.1 atm***

69) a. $X_{CH_4} = \frac{0.175\text{ atm}}{0.175 + 0.250\text{ atm}} = 0.412$ $\quad X_{O_2} = 1 - 0.412 = 0.588$

b. $PV = nRT$

$(0.425\text{atm})\ 10.5\text{L} = n\,(0.08206)\ 338\text{K}$ $\quad n = 0.161\text{ mol}$

c. $n_{CH_4} = 0.412\,(0.161\text{ mol}) = \frac{0.0663\text{mol } CH_4}{} \left| \frac{16.042\text{ g } CH_4}{1\text{ mol } CH_4} \right. = 1.06\text{ g } CH_4$

$n_{O_2} = 0.588\,(0.161\text{ mol}) = \frac{0.0947\text{ mol } O_2}{} \left| \frac{32.00\text{ g } O_2}{1\text{ mol } O_2} \right. = 3.03\text{ g } O_2$

71) a. $P_{H_2} = 1.032 - 0.042\text{ atm} = 0.990\text{ atm}$

b. $PV = nRT$

$(0.990)\ 0.240\text{L} = n\,(0.08206)\ 303\text{K}$

$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

$n = \frac{0.00956\text{ mol } H_2}{} \left| \frac{1\text{ mol Zn}}{1\text{ mol } H_2} \right| \frac{65.38\text{g Zn}}{1\text{ mol Zn}} =$ ***0.625g Zn***

73) $P_{O_2} = 734 - 19.8\text{ torr} = 714.2\text{ torr} = 0.940\text{ atm}$

$PV = nRT$

$(0.940)\ 0.0572 = n\,(0.08206)\ 295$

$2NaClO_3 \longrightarrow 2NaCl + 3O_2$

$n = \frac{0.00222\text{ mol } O_2}{} \left| \frac{2\text{ mol } NaClO_3}{3\text{ mol } O_2} \right| \frac{106.44\text{g } NaClO_3}{1\text{ mol } NaClO_3} = 0.158\text{ g } NaClO_3$

$\frac{0.158\text{ g } NaClO_3}{0.8765\text{ g mixture}} \times 100 = 18.0\%\ NaClO_3$

96) $Br_2 + 3F_2 \longrightarrow 2B_xF_y$ (volume ratio = molar ratio)

$x = 1$ $\quad y = 3$, so the product is BF_3

109) $P_{N_2} = 726 - 23.8\text{ torr} = 702.2\text{ torr} = 0.924\text{ atm}$

$PV = nRT$

$(0.924)\ 0.0318 = n\,(0.08206)\ 298$

$n = \frac{0.00120\text{mol } N_2}{} \left| \frac{28.02\text{g } N_2}{1\text{ mol } N_2} \right. = \frac{0.03367\text{ g } N_2}{0.253\text{ g compound}} \times 100 = 13.3\%\ N$